Floor Systems

Jeffrey Domingoes
Drafting & Design Instructor
Chariho Career & Technical Center

Introduction

Purpose: To expose the student to the various aspects of designing a floor system for a building.

Core Objective: For the student to be able to design a flooring system for a building using the knowledge obtained in this core learning experience.

Objectives:

- Comprehension of the Glossary of Terms needed to understand the proper vocabulary used to explain the materials and conditions of a flooring system.
- The capability to interpret a floor joist span chart to be able to specify the proper floor joist needed for their particular flooring system.
- A working knowledge of framing techniques used to frame a flooring system.
- The ability to create all of the necessary working drawings that will allow the builder to properly construct the floor being designed.
- The student will construct a model of the framing needed to construct their floor.

Estimated Time: 2 weeks

Standards

Industry Standards:

New Standards Performance Standards:

E1c. The student reads and comprehends informational materials to develop understanding and expertise and produces written or oral work that:

- **restates or summarizes information;**
- **relates new information to prior knowledge and experience;**
- **extends ideas;**

makes connections to related topics or information.

E3a. The student participates in one-to-one conferences with a teacher, paraprofessional, or adult volunteer, in which the student:

- initiates new topics in addition to responding to adult-initiated topics;
- **asks relevant questions;**
- **responds to questions with appropriate elaboration;**
- uses language cues to indicate different levels of certainty or hypothesizing, e.g., "what if...," "very likely...," "I'm unsure whether..."

confirms understanding by paraphrasing the adult's directions or suggestions.

M1. Number and operation concepts

The student produces evidence that demonstrates understanding of number and operation concepts; that is, the student:

M1a. Uses addition, subtraction, multiplication, division, and exponentiation in forming and working with numerical or algebraic expressions (the statement has been modified).

M1e. Represents numbers in decimal or fraction form and in scientific notation, and graphs numbers on the number line and number pairs in the coordinate plane.

M1f. Compares numbers using order relations, differences, ratios, proportions, percents, and proportional change.

M1g. Carries out proportional reasoning in cases involving part-whole relationships and in cases involving expansions and contractions.

M1h. Understands dimensionless numbers, such as proportions, percents, and multiplicative factors, as well as numbers with specific units of measure, such as numbers with length, time, and rate units.

M2. Geometry and Measurement Concepts

The student produces evidence that demonstrates understanding of geometry and measurement concepts; that is, the student:

M2a. Models situations geometrically to formulate and solve problems.
M2b. Works with two- and three- dimensional figures and their properties, including polygons and circles, cubes and pyramids, and cylinders, cones, and spheres.
M2c. Uses congruence and similarity in describing relationships between figures.
M2d. Visualizes objects, paths, and regions in space, including intersections and cross sections of three dimensional figures, and describes these using geometric language.
M2e. Knows, uses, and derives formulas for perimeter, circumference, area, surface area and volume of many types of figures.
M2h. Analyzes figures in terms of their symmetries using, for example, concepts of reflection, rotation, and translation.
M2k. Works with geometric measures of length, area, volume, and angle; and non-geometric measures such as weight and time.
M2l. Uses quotient measures, such as speed and density, that give "per unit" amounts; and uses product measures such as person-hours.
M2m. Understands the structure of standard measurement systems, both SI and customary, including unit conversions and dimensional analysis.
M2n. Solves problems involving scale, such as in maps and diagrams.

M6. Mathematical Skills and Tools

The student demonstrates fluency with basic and important skills by using these skills accurately and automatically, and demonstrates practical competence and persistence with other skills by using them effectively to accomplish a task,

perhaps referring to notes, or books, perhaps working to reconstruct a method; that is, the student:

M6a. Carries out numerical calculations and symbol manipulations effectively, using mental computations, pencil and paper, or other technological aids, as appropriate.
M6b. Uses a variety of methods to estimate the values, in appropriate units, of quantities met applications, and rounds numbers used in applications to an appropriate degree of accuracy.
M6c. Evaluates and analyzes formulas and functions of many kinds, using both pencil and paper and more advanced technology.
M6d. Uses basic geometric terminology accurately, and deduces information about basic geometric figures in solving problems.
M6e. Makes and uses rough sketches, schematic diagrams, or precise scale diagrams to enhance a solution.
M6g. Creates and interprets graphs of many kinds, such as function graphs, circle graphs, scatter plots, regression lines, and histograms.
M6h. Sets up and solves equations, symbolically (when possible) and graphically.
M6l. Uses tools such as rulers, tapes, compasses, and protractors in solving problems.
M6m. Knows standard methods to solve basic problems and uses these methods in approaching more complex problems.

M7. Mathematical Communication

The student uses the language of mathematics, its symbols, notation, graphs, and expressions, to communicate through reading, writing, speaking, and listening, and communicates about mathematics by describing mathematical ideas and concepts and explaining reasoning and results; that is, the student:

M7a. Is familiar with basic mathematical terminology, standard notation and use of symbols, common conventions for graphing, and general features of effective mathematical communication styles.
M7b. Uses mathematical representations with appropriate accuracy, including numerical tables, formulas, functions, equations, charts, graphs, and diagrams.

Applied Learning

A1. Problem Solving

Design a product, service, or system

A1a. The student designs and creates a product, service, or system to meet an identified need; that is, the student:

- **develops a design proposal (the statement has been shortened);**
- **plans and implements the steps needed to create the product, service, or system;**
- **makes adjustments as needed to conform with specified standards or regulations regarding quality or safety;**
- **evaluates the product, service, or system in terms of the criteria established in the design proposal (the statement has been modified).**

Improve a system

A1b. The student troubleshoots problems in the operation of a system in need of repair or devises and tests ways of improving the effectiveness of a system in operation; that is, the student:

- **explains the structure of the system (the statement has been modified);**
- **analyzes the way the system works, taking account of its functional, aesthetic, social, environmental, and commercial requirements, as appropriate, and using a relevant kind of modeling or systems analysis;**
- **evaluates the operation of the system, using qualitative methods and/or quantitative measurements of performance;**
- **develops and tests strategies to put the system back in operation and/or optimize its performance;**
- **evaluates the effectiveness of the strategies for improving the system and supports the evaluation with evidence.**

A2. Communication Tools and Technologies

A2a. The student makes an oral presentation of project plans or findings to an audience with expertise in the relevant subject matter; that is, the student:

- **organizes the presentation in a logical way appropriate to its purpose;**
- **adjusts the style of presentation to suit its purpose and audience;**
- speaks clearly and presents confidently;
- **responds appropriately to questions from the audience;**
- **evaluates the effectiveness of the presentation and identifies appropriate revisions for a future presentation.**

A2c. The student develops a multi-media presentation, combining text, images, and/or sound; that is, the student:

- selects an appropriate medium for each element of the presentation;
- uses the selected media skillfully, including editing and monitoring for quality;
- **achieves coherence in the presentation as a whole;**
- **communicates the information effectively, testing audience response and revising the presentation accordingly.**

A3. Information Tools and Technologies

A3a. The student gathers information to assist in completing project work; that is, the student:

- identifies potential sources of information to assist in completing the project;
- uses appropriate techniques to collect the information, e.g., considers sampling issues in conducting a survey;
- **interprets and analyzes the information**
- **evaluates the information in terms of completeness, relevance, and validity;**
- shows evidence of research in the completed project.

A4. Learning and Self-Management Tools and Techniques

A4a. The student learns from models; that is, the student:

- **consults with and observes other students and adults at work and analyzes their roles to determine the critical demands, such as demands for knowledge and skills, judgment and decision making;**
- **identifies models for the results of project work, such as professionally produced publications, and analyzes their qualities;**
- **uses what he or she learns from models in planning and conducting project activities.**

A4b. The student reviews his or her own progress in completing work activities and adjusts priorities as needed to meet deadlines; that is, the student:

- **develops and maintains work schedules that reflect consideration of priorities;**
- **manages time;**
- **monitors progress towards meeting deadlines and adjusts priorities as necessary.**

A4c. The student evaluates his or her performance; that is, the student:

- **establishes expectations for his or her own achievement;**
- **critiques his or her wok in light of the established expectations;**
- **seeks and responds to advice and criticism from others.**

ITEA Standards:

Technology Content Standard	**Technology Content Standard Benchmarks**
1. Students will develop an understanding of the characteristics and scope of technology.	In order to comprehend the scope of technology, students in grades 9-12 should learn that **J**. The nature and development of technological knowledge and processes are functions of the setting. **K**. The rate of technological development and diffusion is increasing rapidly. **L.** Inventions and innovation are the results of specific, goal-directed research. **M.** Most development of technologies these days is driven by the profit motive of the market.
2. Students will develop an understanding of the core concepts of technology.	In order to recognize the core concepts of technology, students in grades 9-12 should learn that **W.** Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems. **X**. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems. **Y.** The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop. **Z.** Selecting resources involves tradeoffs between competing values, such as availability, cost, desirability, and waste. **AA.** Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. **BB.** Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. **CC.** New Technologies create new processes. **DD.** Quality control is planned process to ensure that a product, service, or system meets established criteria. **EE.** Management is the process of planning, organizing, and controlling work. **FF.** Complex systems have many layers of controls and feedback loops to provide information.
3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	In order to appreciate the relationships among technologies, as well as with other fields of study, students in grades 9-12 should learn that **G.** Technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **H.** Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, and across other fields. **I.** Technological ideas are sometimes protected through the process of patenting.

	J. Technological progress promotes the advancement of science and mathematics.
4. Students will develop an understanding of the cultural, social, economic, and political effects of technology.	In order to recognize the changes in society caused by the use of technology, students in grades 9-12 should learn that **H.** Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. **I.** Making decisions about the use of technology involves weighing the trade-off between the positive and negative effects. **J.** Ethical considerations are important in the development, selection, and use of technologies. **K.** The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.
5. Students will develop an understanding of the effects of technology on the environment.	In order to discern the effects of technology on the environment, students in grades 9-12 should learn that **G.** Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling. **H.** When new technologies are developed to reduce the use of resources, considerations of tradeoffs are important. **I.** With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making. **J.** The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. **K.** Humans devise technologies to reduce the negative consequences of other technologies. **L.** Decisions regarding the implementation of technologies involve the weighing of trade-off between predicted positive and negative effects on the environment.

6. Students will develop an understanding of the role of society in the development and use of technology	In order to realize the impact of society on technology, students in grades 9 - 12 should learn that **H.** Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values. **I.** The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures. **J.** A number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads contribute to shaping the design of and demand for various technologies.
7. Students will develop an understanding of the influence of technology on history.	In order to aware of the history of technology, students in grades 9-12 should learn that **G**. Most technological development has been evolutionary, the result of a series of refinements to a basic invention. **H.** The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials. **I.** Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape. **J.** Early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how. **K.** The Iron Age was defined by the use of iron and steel as the primary materials for tools. **L**. The Middle Ages saw the development of many technological devices that produced long-lasting effects on technology and society. **M**. The Renaissance, a time of rebirth of the arts and humanities, was also an important devilment in the history of technology. **N.** The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time. **I.** The Information Age places emphasis on the processing and exchange of information.
8. Students will develop an understanding of the attributes of design.	In order to recognize the attributes of design, students in grades 9-12 should learn that **H.** The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing and evaluating the design using specifications, refining the design, creating or making it, communicating processes and results. **I.** Design problems are seldom presented in a clearly defined form. **J.** The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. **K.** Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.
9. Students will develop and understanding of engineering design.	In order to comprehend engineering design, students in grades 9-12 should learn that **I.** Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. **J.** Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. **K**. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. **L.** The process of engineering design takes into account a number of factors.
10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem-solving.	In order to be able to comprehend other problem-solving approaches, students in grades 9-12 should learn that **I.** Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace. **J.** Technological problems must be researched before they can be solved. **K.** Not all problems are technological, and not every problem can be solved using technology. **L.** Many technological problems require a multidisciplinary approach.

11. Students will develop the abilities to apply the design process.	As part of learning how to apply design processes, students in grades 9-12 should be able to **M.** Identify the design problem to solve and decide whether or not to address it. **N.** Identify criteria and constraints and determine how these will affect the design process. **O.** Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. **P.** Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. **Q.** Develop and produce a product or system using a design process. **R**. Evaluate final solutions and communicate observation, proceses, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.
13. Students will develop the abilities to assess the impact of products and systems.	As part of learning how to assess the impact of products and systems, students in grades 9-12 should be able to **J.** Collect information and evaluate its quality. **K.** Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment. **L**. Use assessment techniques, such as trend analysis and experimentation to make decisions about the future development of technology. **M.** Design forecasting techniques to evaluate the results of altering natural systems.

20. Students will develop an understanding of and be able to select and use construction technologies.	In order to select, use, and understand construction technologies, students in grades 9-12 should learn that J. Infrastructure is the underlying base or basic framework of a system. K. Structures are constructed using a variety of processes and procedures. L. The design of structures includes a number of requirements. M. Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use. N. Structures can include prefabricated materials.

Rubric

[1. Modify rubric template as desired. **2.** Rubric should address standards listed on Standards page. **3**. Include additional rubrics if necessary**]**

Scale/Criteria	**needs to work substantively in this area in order to meet the standard** **1**	**shows progress toward the standard** **2**	**meets the standard** **3**	**exceeds the standard** **4**
Note Taking	No notes in notebook. Minimal notes with no connection to each other.	Some notes in notebook but not enough detail to be sufficient to study from.	Good note taking. Notes are clear and easy to follow. Adequate attention to detail.	Excellent note taking. Particular attention to detail. Clear and easy to follow. Detail drawings are labeled accurately.
Utilizing Span Charts	Span Chart missing from folder. Wrong section highlighted. Can not identify which size joist is necessary for their floor plan.	Can follow the basic concept of the chart but unclear which floor joist would work for their floor plan.	Can identify which joist should be used for their particular floor framing plan. Proper section is highlighted.	Proper section is highlighted in each Span Chart. Has supplied more than one option for the size of their joists in their floor framing plan.
Drafting Framing Plan	Missing Plan. Plan doesn't match floor plan or foundation. No/improper framing members shown on plan. Labeling of plan missing.	Improperly sized framing members shown or labeled. Labeling of framing members missing.	Proper framing members shown on the framing plan. Adequate details drawn on the plan. Proper labeling of members.	Proper framing members shown on the plan as well as labeling. All framing situations properly labeled and drawn. Neat, precise drawings.
Constructing Floor Framing Model	No model. Poorly constructed model. Wrong/no scale of model. Model does not match Framing Plan	Minor differences between model and framing plan. Model not constructed in the same manner as it would be built in the real world. Details left out.	Model matches framing plan. Proper construction method of model.	Model matches Framing Plan. Proper construction method used to build model. Larger scaled model of details of the framing model at different framing conditions.

Core Learning Experience Summary Chart

Student Tasks & Instructional Methodology for Each Learning Experience		
Student Learning Experiences	**Student Tasks**	**Instructional Methodologies**
Exposure to Floor Framing System	• Note taking during lecture • Narrowing down of framing technique that will be used to frame floor system	Lecture
Span Charts	• Note taking during lecture • Interpret Span Chart to apply information to their individual floor framing project	Lecture and active participation by the student by applied knowledge techniques
Floor Framing Plan	• Create a Floor Framing Plan using the information obtained in the previous learning experiences	Lecture and active participation by the student by applied knowledge techniques
Floor Framing Model	• Create a scaled wooden model of the framing plan needed to construct the student's one story house	Lecture and active participation by the student by applied knowledge techniques

Description of Core Assessment: product & performance

Student Learning Experiences

For each student learning experience, include the following information:

1. State purpose
2. Estimate time
3. List standards – a subset of those cited in core assessment
4. List key concepts that the lesson will address.
5. List learning tasks.
6. **Explain how tasks require higher-level thinking. The Performance Standards e-mailed to you identify in bold type those standards which comprise higher level thinking.**
7. List teacher responsibilities.
8. Optional: Describe assessment – include only if an assessment is included as part of the learning experience.
9. Optional: Include rubric(s) – include only if additional rubrics are necessary to complement rubrics that describe core assessment product and performance
10. List materials & equipment
11. List resources
12. Provide copies of all handouts necessary for students to complete the learning task.

[Integrative/review experience: If there is a sufficient number of student learning experiences, develop an integrative/review experience which consists of the sections listed above**.]**

Student Learning Experience 1

Purpose: Expose students to the process of designing a floor system for a one story house.

Estimated Time: 1 day

Standards:

Key Concepts Addressed:

- Glossary of Terms & Conditions
- Overview of Framing Plan and Span Charts
- Exposure to different materials and techniques used to frame a floor system
- Relationship between Foundation Plan, Floor Plan and Framing Plan

Student Tasks:

- Note taking during lecture period of lesson
- Become familiar with the various terms and techniques used in framing a floor system
- Begin to narrow down the various options available to frame their individual floor system

Explanation of how learning tasks require higher-level thinking:

The student must use their notes, handouts and existing plans to determine which framing system and available materials best suits their needs to effectively and efficiently design a working floor system for their individual house design.

Teacher Responsibilities:

- Involve the class in a discussion on how to design a floor system for a one story house.
- Introduce terms and conditions that the students will need to comprehend in order to develop the necessary plans
- Explain a framing plan and span chart to the students
- Explain the different materials that can be used to build a floor system
- Supervise the students in deciding which materials and system would be best for their individual designs

Materials & Equipment: Span Chart handout
Sample Framing Plan
Glossary of Terms & Conditions handout

Resources: Architectural Graphic Standards
Architecture Textbook

Student Learning Experience 1 Appendix

[Include copies of all student handouts. **The appendix content is central to the core learning experience and should follow 1 inch margins and Times New Roman/Geneva font.]**

Student Learning Experience 2

Purpose: To teach student how to read the Span Chart and apply this knowledge to size the floor joists or trusses needed to construct their floor system.

Estimated Time: 1 day

Standards:

Key Concepts Addressed:

- Interpretation of the Span Charts
- Advantages and disadvantages of Framing Lumber vs. Trusses
- Using the Span Charts to specify the joist size needed for the student's individual floor system.

Student Tasks:

- Note taking during lecture
- Applying the information on the Span Charts to their individual project to determine which framing system is most efficient, Framing Lumber or Trusses
- Calculate what size Joists are needed for their floor system

Explanation of how learning tasks require higher level thinking:

The student must use their notes, handouts and existing plans to determine which particular framing system and available materials best suits their needs to effectively and efficiently design a working floor system for their individual house design. They then must interpret the Span Chart to determine which particular size is appropriate for their floor system.

Teacher Responsibilities:

- Thoroughly explain how to interpret the Span Charts for framing lumber and trusses

- Involve the class in a discussion on when is the appropriate situation to use framing lumber or trusses in a floor system
- Discuss how to apply the information in the Span Charts to determine what size joists are needed to create a floor system

Materials & Equipment:

Span Charts for Framing Lumber and Trusses
Existing Floor Plan (student)
Existing Foundation Plan (student)

Resources: Architectural Graphic Standards
Architecture Textbook

Student Learning Experience 2 Appendix

[Include copies of all student handouts. **The appendix content is central to the core learning experience and should follow 1 inch margins and Times New Roman/Geneva font.]**

Student Learning Experience 3

Purpose: To Create a Floor Framing Plan

Estimated Time: 3 Days

Standards:

Key Concepts Addressed:

- Relating data from Span Charts to Framing Plan
- Floor Framing Details
- Floor Framing Techniques
- Floor Framing Plan

Student Tasks:

- Note taking during lecture
- Relate the data found in Span Chart assignment to the Framing Plan
- Determine which Framing Details and Techniques apply to the student's individual Floor Framing Plan
- Draft a Floor Framing Plan

Explanation of how learning tasks require higher level thinking:

The student must apply previously learned abstract knowledge to the current assignment to create the required Floor Framing Plan. He or she must take all of the information gathered and use it to create a graphic representation of the Floor Framing System.

Teacher Responsibilities:

- Lead a discussion about the correlation of the Span Charts and the Floor Framing Plan
- Discuss typical framing techniques commonly used in construction
- Explain various framing details that architects may use to show certain framing situations

- Show the students what a typical Floor Framing Plan looks like so they have a guide to reference while drawing their own individual plan

Materials & Equipment: Existing Floor Plan
Existing Foundation Plan
Drafting supplies
Span Charts
Framing Detail handout
Typical Framing Plan handout

Resources: Architectural Graphic Standards
Architecture Textbook

Student Learning Experience 3 Appendix

[Include copies of all student handouts. **The appendix content is central to the core learning experience and should follow 1 inch margins and Times New Roman/Geneva font.]**

[core assessment: complete core assessment page]

Core Assessment

Estimated Time: 1 week

Student Tasks (product and performance): Construct a scale model of their Floor Framing System using their floor framing plan as a guide.

Explanation of How Assessment Tasks Require Higher Level Thinking:

The student must apply previously learned knowledge and skills to a new assignment which requires a new set of skills built upon the prior information obtained. The student must turn abstract theory into an actual physical entity.

Teacher's Responsibilities:

- Instruct students on proper safety practices while operating saws, knives and hammers
- Explain to the students verbally and visually what is expected from them as a finished product
- Overseeing the construction of the Framing System model

Materials & Equipment: Framing Plan
Scaled lumber and trusses

Resources: Architectural Graphic Standards
Architecture text

Core Assessment Appendix

[Include copies of all student handouts necessary to complete core assessment**]**